Specification
Combination Gas/Light Oil Burners

1.0 General Requirements

A. Furnish three (3) combination gas/light oil burners for retrofit on the three (3) existing Johnston 16,000 lb/hr fire tube boilers. The burner design, construction, components and installation shall meet all applicable code requirements. Basis of Design is Power Flame CMAX model CM10C-GO-30 burner with Director SCS Supervisory Control master lead lag system.

2.0 General Burner Description

A. The burner shall be a forced draft flame retention burner capable of burning 20,950 MBH of natural gas against 6.5 in wc furnace pressure. Gas pressure applied to the burner gas train supply connection shall be a minimum of 5 psig at full high rate and a maximum of 12 psig at static conditions. Each burner shall be capable of burning 144 GPH of No. 2 fuel oil with a rating of 140,000 BTU/GAL. Windbox/register design burners shall not be accepted.

3.0 Approval Codes

A. Each burner shall be supplied with components suitable for field approval and each component shall bear the appropriate CUL label. In addition to the CUL requirements, all equipment and installation procedures shall meet the local and national code requirements. Each burner shall be designed and constructed as an integrated combustion system package and shall be factory fire tested. The burner manufacturer shall furnish a three dimensional AutoCAD drawing of the burner to assure proper fit up to the boiler.

4.0 Combustion Head Design

A. Each burner shall be of welded steel construction and have a baked on powder coat finish. The combustion head shall incorporate a multi blade, stainless steel, flame retention diffuser. The gas firing head shall include a series of gas injection spuds that distribute the fuel evenly around the periphery of the diffuser assembly. A gas annulus shall provide a secondary layer of fuel to create a premix and staging effect to achieve maximum fuel/air mixing and minimal emissions. Burners with cast alloy blower housings shall not be accepted. The burner combustion head shall carry full five (5) year replacement warranty.

B. The burner combustion head components shall be easily accessible through an access door located on the side of the burner blast tube. The burner combustion head components shall be easily adjusted or replaced, and the oil gun assembly maintained without having to disconnect fuel supply piping or electrical connections to the burner assembly.

C. All air required for combustion shall be supplied by a blower mounted integral to the burner. The blower wheel shall be of the backward inclined centrifugal design and shall be directly driven by a 20 HP 3450 RPM, 480 volt, 60 Hertz three phase TEFC high efficiency motor, larger motors shall not be acceptable. A multiple blade damper assembly located on the inlet side of the blower wheel and VFD drive shall meter the combustion air flow. The inlet damper assembly shall have a top opening and flanged inlet to facilitate connection to the combustion air supply.

5.0 Ignition System

A. The burner ignition system shall utilize natural gas as the fuel source. The gas pilot system components shall include spark ignited pilot assembly, 6,000 Volt ignition transformer, pilot solenoid valve, pilot gas pressure regulator and manual gas shutoff cock. The flame proving system shall incorporate a Ultra-Violet flame detector, which shall monitor both the pilot and main flames. The pilot assembly shall fit within the confines of the blast tube - avoiding special burner front plate pilot cut outs.

6.0 Fuel/Air Control System

A. Modulation

The main On-Off gas supply shall be controlled by the motorized gas valves. The main oil supply shall be controlled by a solenoid oil valve. A servo motor shall control the modulated positioning of the air inlet dampers, butterfly type gas proportioning valve and a metering type oil valve and blower motor VFD to best meet varying system load conditions.

The positioning of the servo motor shall be controlled by a 4-20 milliamp, modulating type pressure controller. When the operating control is satisfied the burner shall shutoff and return to the low fire start position. The servo motor and control system shall provide an electrical interlock to insure a guaranteed low fire start position prior to the pilot trial for ignition sequence.

7.0 Gas Control Train

A. The existing main gas train shall be replaced with a new gas train using Maxon 5000 gas valves and a Rockwell regulator. The burner manufacturer to provide specified Fuel/Air Control System operation capable of a 10:1 turndown and shall provide the main gas flow control valve and servo motor.

B. Provide a Gas Mass Flowmeter and temperature transmitter for each burner. To include a 4 to 20ma analog output for Director SCS to monitor gas usage by each burner. Includes microprocessor and 2 line x 16 character, backlit display to view flow rate, total, elapsed time, gas temperature and alarms.

C. Reuse the existing 2 inch natural gas filter at the beginning of the gas train.

8.0 Oil Control Train

A. General Requirements

The oil train shall incorporate CUL approved components as supplied by the burner manufacturer to provide specified Fuel/Air Control System operation capable of a 6:1 turndown.

B. Fuel flow to the air atomizing nozzle shall be delivered by a single or two stage gear type pump capable of producing 100 PSIG discharge pressure and 15 in. hg. Vacuum. It shall be a separate unit mounted on its own support base with direct drive motor. The unit shall be complete with suction line manual gate valve, removable mesh type oil strainer, 0-30" HG, 0-30 PSIG combination vacuum - pressure gauge with gauge dampening orifice, 0-100 PSIG oil nozzle pressure gauge with gauge dampening orifice. Two nozzle line oil solenoid safety shutoff oil valves with proof of closure are required.

C. Additional oil components shall be provided as follows:

1. Low oil pressure switch

D. Burner mounted air atomizing piping train shall consist of solenoid shutoff valve, low atomizing air pressure switch and pressure gauge with shutoff cock.

E. An air compressor for each burner shall be supplied for atomization of the fuel oil.

F. Two (2) safety shut-off valves with proof of closure.

9.0 Burner Operating Controls

A. The On-Off operation of the burner shall be controlled by a pressure control. System pressure shall be 110 PSIG.

B. A safety manual reset type limit control shall be provided to shut the burner down in the event of excessive pressure.

C. Modulation. The position of the modulating servomotors and other fuel/air components shall be controlled by a 4-20 milliamp pressure control in addition to the On-Off operating control.

10.0 Flame Safeguard Control

A. Each burner shall be complete with a remote mounted control panel which shall house all required operating electrical components. All flame safeguard wiring within the combustion control system shall be factory pre-wired utilizing a UL listed components and have U. L. Flame Safeguard panel approval label. All optional controls shall be wired to a din rail mounted terminal strip within the control panel. A junction box pre-wired to the burner components shall be mounted on the burner. It shall have a din rail mounted terminal strip, which shall match the terminal strip in the remote control panel. Field wiring shall be required between the burner mounted junction box and the remote control panel. All wiring shall be numbered and color coded to facilitate field wiring connections. All devices on the face of the control panel shall have engraved laminated labels name plates. All relays, control devices and items mounted inside the panel shall be identified with laminated or engraved name plates. Blower motor shall be controlled via variable speed drive with display. The VFD shall be mounted by the burner assembly or in the control panel.

B. Appropriate electrical knockouts shall be provided on both sides and bottom of the panel to allow for necessary power and limit control wiring. The control panel shall be constructed of 16 gauge steel and shall be complete with a top mounted switch and control section which shall be hinged to allow for full access to all panel mounted components. The panel shall include a lock and key. The control panel shall have a powder coat painted finish identical to the burner being supplied.

C. The control panel shall include a din rail mounted control circuit transformer with integral fuses on both the primary and secondary windings. Flame safeguard control as specified below. Din rail mounted motor starters, relays, terminal blocks and other electrical devices as required. Provide indicator lights or LEDs for “Power On”, “Demand”, “Main Fuel”, “Flame Failure” and “Ignition”. All lockout conditions shall sound an alarm, panel mount an auto-rest alarm silencing switch and alarm buzzer. Panel mounted fused disconnect for single point field electrical connection. Provide terminals for remote emergency stop field connections.

11.0 Combustion & Boiler Control System

A. **General:** Each burner shall be furnished with an integrated flame safeguard, parallel position & Boiler Control System providing technology and function to monitor and control the boilers as defined here-in. The system shall be factory equipped with a Pre-Configured Controller and Human Interface (HMI).

B. **Major Functions:**

1. Parallel Positioning Control for precise control of Fuel/Air ratio
2. Servo Motors for main gas & oil, and combustion air
3. Variable Speed Drive (VFD) for Burner Combustion Air Fan to minimize energy costs. 20 hp blower motor maximum.
4. Linkage-Less Full Modulation for Control (PID Algorithm)
5. Burner Sequencing: Light off/shutdown, pre and post purge (to meet FM/IRI/UL)
7. Full Flame Safe Guard Functions (to meet IRI/FM/CUL)
8. Annunciation & Diagnostics
9. LCD Display Interface & Monitoring on each burner

10. BMS Interface to Metasys 5.2
11. 15 inch LCD Lead lag control for the three boilers

C. **Major System Components:**

1. Programmable Controller: Replaceable main control unit shall be re-commissioned by downloading parameters from a back-up storage in the programming and display unit or PC and shall not require re-programming or re-commissioning. Basis of Design Siemens LMV 52.
2. LCD Display
3. MODBUS to Metasys 5.2 Communication Network
4. Integral Burner Management Controller
5. One Flame Scanner
6. One Flame Amplifier
7. Pressure Sensors as required
8. End Devices: VFD & Servo Motors
9. Power Flame Director SCS Supervisory master lead lag control system

D. **LED Display & Interface Monitoring:**

1. Manual control of the boiler firing rate utilizing control pushbuttons to increment and decrement the firing rate.
2. Indication of burner status and diagnostics
3. Indication of connected pressure sensor readings
4. On screen display of system alarms and faults
5. On screen history of alarms and faults

E. **Integrated Boiler Controls:**

1. Operating and Modulating Control
2. Primary Low Water Cut-Off
3. Variable Speed Drive fault shutdown
4. Password protection of Programmable Controller Logic
5. Password protection of Parallel Positioning Control

F. **Transmitters and Sensors:**

1. Variable Speed Drive Sensor
2. Combustion Air Temperature Transmitter
3. Natural gas flowmeter and temperature Transmitter
4. Stack Temperature Transmitter
5. Steam Pressure Transmitter

G. **Field End Device:**

1. Variable Frequency Drive
2. Servo Motors as required

H. **Director SCS Supervisory Control lead lag System Features**

1. Lead-Lag control of 3 burners
2. Night or weekend setback feature
3. Series or unison modulation
4. Standby boiler warming
5. Auto rotate lead boiler selection
6. Touch screen setup
7. Optional analog inputs and display
8. Email alerts

9. Software is updatable with USB flash drive
10. Remote view with internet explorer over in house network or over the internet
11. Additional analog inputs for pressure and flow.
12. Re-settable totalizers and trending for flows.
13. Interface to transmit data to a higher level BMS specifically Metasys 5.2
14. Includes header pressure sensor
15. 15 inch color lead-lag system touch screen.
16. Color graphics of operation and burner data
17. Graphic trending for fine tuning of system performance
18. Run time counters and animated burner operation
19. Easy setup and adjustment
20. Include two days of operator training after start-up

12.0 Burner Start Up Information and Test Data

B. On completion of the burner system start up - the installing contractor shall complete the "Burner Start Up Information and Test Data" form and "Control Settings" form (both attached) and deliver to the Owner.

13.0 NOx requirements

A. The burner(s) shall be capable of clean semi-low NOx operation without Induced flue gas recirculation.

B. Internal recirculation and staged air burners, where portions of the main flame are combusted within the burner head, behind a cone or diffuser assembly shall not be acceptable due to the potential for burner head failure caused by the resultant thermal stress of the referenced components.

C. Steam injection emissions reduction burners shall not be acceptable because of the potential of deposits on, and/or damage to heat transfer surface and refractory - and also due to the cost of steam.

D. At the time of bid, burner manufacturer shall specify the NOx reduction method and guarantee that, on natural gas firing, NOx emissions shall not exceed 60 PPM on natural gas and 100 ppm on fuel oil, and CO emissions shall not exceed 100 PPM. All emissions measurements corrected to 3% O_2.

The burner manufacturer shall have a minimum of fifteen (15) years experience in the design and installation of standard, semi-low NOx and low NOx burner systems.

14.0 Documentation

A. The burner manufacturer shall furnish as a minimum a burner specification sheet, comprehensive Bill of Material, piping diagram, ladder logic wiring diagram and job specific 3-D model of the complete burner that includes dimensional information, “see through” feature for viewing internal assemblies and component identification.

15.0 Delivery

A. Delivery of the equipment is critical to meet the retrofit schedule. Equipment must be delivered to the jobsite within seven (7) weeks after release to manufacture.

BURNER START UP INFORMATION & TEST DATA

The following information shall be recorded for each burner start up:

Power Flame Model _____ Job No. _____ Serial No. _____

Installation Name _____ Start Up Date _____

Start Up Contractors Name _____ Phone _____

Name of Technician doing Start Up _____

Type of Gas: Nat. ☐ LP ☐ Other ☐ Fuel Oil Grade No. _____

Gas Firing

Gas Pressure at Train Inlet

Burner in Off Position _____ "W.C.
Low Fire _____ "W.C.
High Fire "W.C.

Gas Pressure at Firing Head

Low Fire _____ "W.C.
High Fire _____ "W.C.

Gas Pressure at Pilot Test

Tee _____ "W.C.

Flame Signal Readings

Pilot _____
Low Fire _____
High Fire _____

CO_2

Low Fire _____ %
High Fire _____ %

CO

Low Fire _____ PPM
High Fire _____ PPM

Input Rate

Low Fire _____ BTU/HR
High Fire _____ BTU/HR

Overfire Draft

Low Fire _____ "W.C.
High Fire _____ "W.C.

O2 _____ %
Low Fire _____ %
High fire

Stack Outlet Test Point Draft

Low Fire _____ "W.C.
High Fire _____ "W.C.

Net Stack Temperature

Low Fire _____ ° F
High Fire _____ ° F

Combustion Efficiency

Low Fire _____ %
High Fire _____ %

_____ %
_____ %

Oil Firing

High Fire Vacuum Reading on Oil

Pump Inlet _____ "H.G.

Gas pressure at Pilot Train

Inlet (if applicable) _____ "W.C.

Gas Pressure at Pilot Test

Tee (if applicable) _____ "W.C.

Oil Nozzle Supply Pressure

Low Fire _____ PSIG
High Fire _____ PSIG

Oil Nozzle Atomizing Medium Pressure

Low Fire _____ PSIG
High Fire _____ PSIG

Flame Signal Readings

Pilot (if applicable) _____ D.C. Volts
Low Fire _____
High Fire _____

GPH Firing Rate

Low Fire _____ GPH
High Fire _____ GPH

CO_2

Low Fire _____ %
High Fire _____ %

Bacharach Scale Smoke Number

Low Fire _____
High Fire _____

O2

Low Fire _____ %
High Fire _____ %

Over Fire Draft

Low Fire _____ "W.C.
High Fire _____ "W.C.

Stack Outlet Test Point Draft

Low Fire _____ "W.C.

Net Stack Temperature

Low Fire _____ F
High Fire _____ F

Combustion Efficiency

Low Fire _____ %
High Fire _____ %

Control Settings

Operating control cut out setting _____
Operating control cut in setting _____

Limit control cut out setting _____
Limit control cut in setting _____

Power supply: Volts _____ Ph _____ Hz _____
Control circuit: Volts _____
Blower motor amps at high fire _____

Other _____

Gas

Low gas pressure switch _____ "W.C.
High gas pressure switch _____ "W.C.

Other _____

Oil

Low oil pressure switch _____ lbs.
High oil pressure switch _____ lbs.
Atomizing low pressure switch _____ lbs.

Oil pump motor amps at high fire _____
Other _____

Operation Checklist

Checked For Proper Operation Of:	Yes	No		Yes	No
Low water cut off			Barometric damper		
High water cut off			Boiler room combustion air &		
Flame safeguard control ignition failure			ventilation provision correct		
Flame safeguard control main flame failure			Oil tank vent system correct		
Burner air flow switch			All oil lines checked for leaks		
Induced draft fan controls			All gas lines checked for leaks		
Over fire draft controls			Gas lines & controls properly vented		
Fresh air damper end switch			Other system components (specify)		

Notified _____ of the following system deficiencies: _____